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A rare cadaveric report of the azygos lobe of the right lung

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Abstract

Variations in the vessels of the mediastinum may cause unexpected complications during thoracic procedures. In this report, we show a rare variation of the azygos vein resulting in an azygos lobe of the right lung in a female cadaver. During routine dissection of the superior mediastinum in a white female cadaver, a variation in the venous anatomy was observed and documented. Further dissection of the middle and posterior mediastinum was performed to follow the course of the anomalous vein, and the right lung was removed. The observed anomalous vein was discovered to be a variation of the azygos vein which arched around the superior lobe of the right lung to unite with the superior vena cava resulting in an azygos lobe of the right lung. Variations in the anatomy of the azygos venous system are not uncommon, and azygos lobes of the right lung are commonly reported as incidental findings on imaging, but not often in cadavers. While individuals with this type of variation are unlikely to present clinically, documenting unusual vascular anatomy of the mediastinum is of interest to avoid unnecessary procedures and unexpected complications during thoracic surgery.

Keywords: anatomical variation; azygos lobe; azygos vein; posterior mediastinum

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Introduction

The azygos vein drains the upper abdomen, back, vertebrae, vertebral canal, and the mediastinal viscera, and forms a pathway for collateral circulation between the superior and inferior vena cavae. The azygos vein typically arises from the union of a branch from the posterior aspect of the inferior vena cava (IVC) and right ascending lumbar vein. The azygos vein ascends in the posterior mediastinum either along the right border of the T4–T12 thoracic vertebrae or midline along the T4–T12 vertebral bodies. The azygos vein then arches over the superior aspect of the root of the right lung to join the superior vena cava (SVC). Along its course, the azygos vein receives multiple tributaries including the posterior intercostal veins, the pericardial, mediastinal, esophageal, and bronchial veins, the hemiazygos and accessory hemiazygos veins, and communicating branches from the vertebral venous plexuses that drain the vertebrae and vertebral canal.^[1]

Clinically, the azygos vein is typically only affected by hemodynamic changes or mediastinal lesions. Changes in the shape and contour of the azygos vein, observed via imaging of the thorax, often provide insight into possible hemodynamic changes. For example, enlargement of the azygos vein is indicative of increased right mean atrial pressure which can be suggestive of constrictive pericarditis, cardiac tamponade, pulmonary hypertension, or portal hypertension.^[2]

Discovering variations in venous anatomy through dissection is not unusual. Variations in the azygos vein course have been previously reported after medical imaging,^[3] but less frequently in cadavers.^[4] These variations included an azygos vein which arches laterally through the right lung to join the SVC forming an azygos lobe of the lung^[5] or an azygos vein that continues directly as the IVC.^[6] Here, we present a rare report of an abnormal azygos vein in a female cadaver which resulted in an azygos lobe.

Case Report

During a routine dissection of the anterior and superior mediastinum in a 70-year-old white female cadaver, an anomalous vein that split the superior lobe of the right lung into a superior and inferior portion was observed. The middle and posterior mediastinum were then dissected to visualize the course of the abnormal vein. Images of the full venous course were then taken.

Upon removal of the anterior portion of the thoracic cage to access the superior and anterior mediastinum, an anomalous vein that divided the superior lobe of the right lung into two portions was observed (**Figure 1a**). After removal of the right lung, the anomalous vein was found to receive contributions from the posterior inter-

costal veins and the IVC and followed a course along the midline of the thoracic vertebrae posterior to the descending thoracic aorta and esophagus (**Figure 1b**), consistent with descriptions of the azygos vein.

The right lung had a superior, middle, and inferior lobe separated by the horizontal and oblique fissures, respectively (**Figure 1c**). The superior lobe of the right lung contained an additional fissure where the anomalous azygos vein passed through the superior lobe dividing the lobe into lateral and medial segments (**Figure 1d**). The medial segment of the divided superior lobe did not have an associated secondary bronchus (**Figure 1e**), consistent with descriptions of an azygos lobe of the right lung.

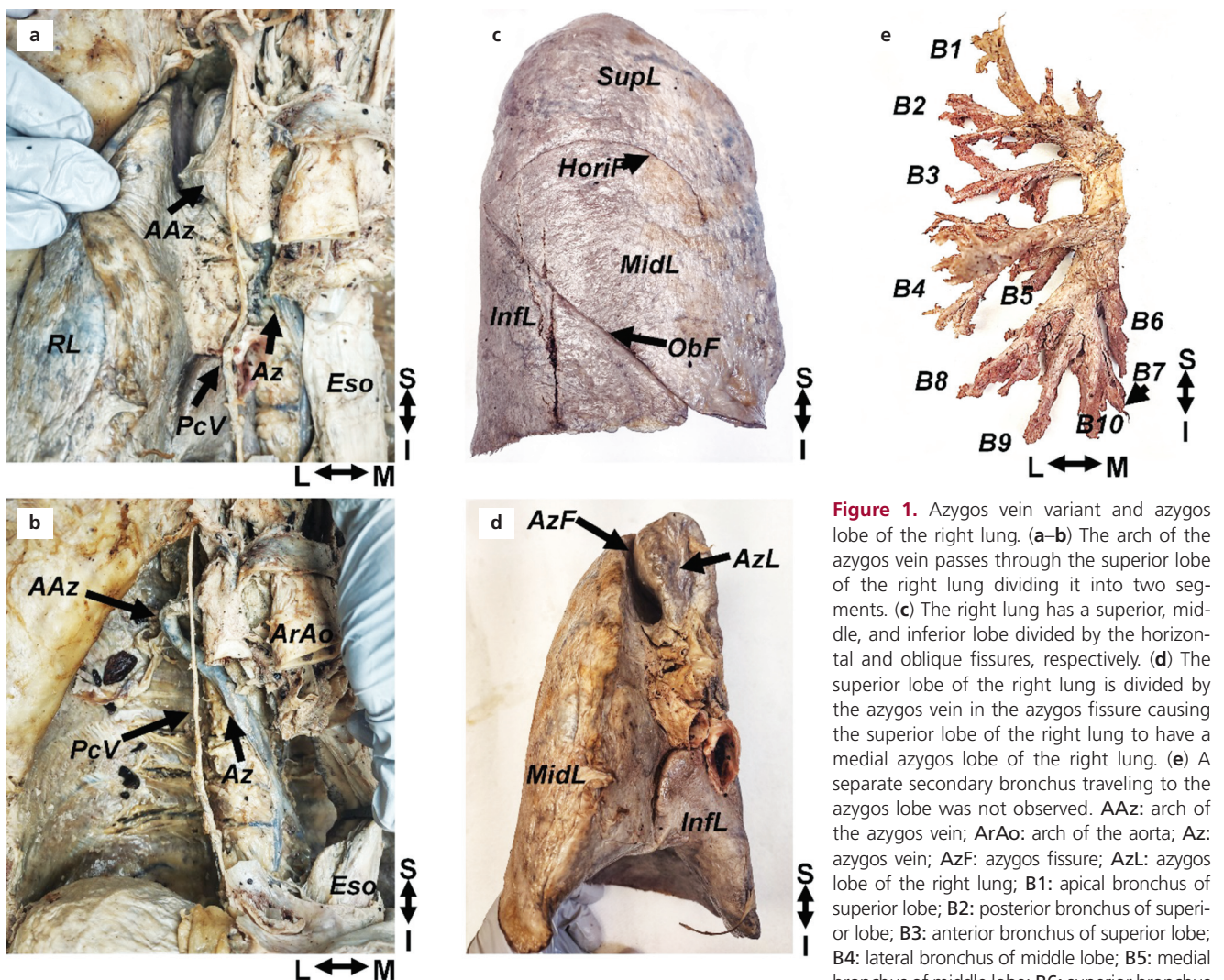


Figure 1. Azygos vein variant and azygos lobe of the right lung. (a–b) The arch of the azygos vein passes through the superior lobe of the right lung dividing it into two segments. (c) The right lung has a superior, middle, and inferior lobe divided by the horizontal and oblique fissures, respectively. (d) The superior lobe of the right lung is divided by the azygos vein in the azygos fissure causing the superior lobe of the right lung to have a medial azygos lobe of the right lung. (e) A separate secondary bronchus traveling to the azygos lobe was not observed. AAz: arch of the azygos vein; ArAo: arch of the aorta; Az: azygos vein; AzF: azygos fissure; AzL: azygos lobe of the right lung; B1: apical bronchus of superior lobe; B2: posterior bronchus of superior lobe; B3: anterior bronchus of superior lobe; B4: lateral bronchus of middle lobe; B5: medial bronchus of middle lobe; B6: superior bronchus of inferior lobe; B7: medial basal bronchus; B8: anterior basal bronchus; B9: lateral basal bronchus; B10: posterior basal bronchus; Eso: esophagus; HoriF: horizontal fissure; I: inferior; InfL: inferior lobe of the right lung; L: lateral; M: medial; MidL: middle lobe of the right lung; ObF: oblique fissure; PcV: pericardiophrenic vessels; RL: right lung; S: superior; SupL: superior lobe of the right lung.

Discussion

We discovered a rare variation of the azygos vein and its associated azygos lobe of the right lung. Typically, the azygos vein branches from the posterior aspect of the IVC and the right ascending lumbar vein. The azygos vein ascends along the right border or the midline of the inferior eight thoracic vertebrae in the posterior mediastinum before arching over the root of the right lung to drain into the superior vena cava.^[1] The azygos venous system is known to vary significantly and rarer variants include an inferior vena cava that underwent agenesis with the drainage of the abdomen and lower limbs instead being routed through the azygos vein.^[6] Additionally, an azygos vein passing through the superior lobe of the right lung has been observed on imaging,^[5] but less frequently in cadavers,^[4,7,8] and far less commonly in females, 0.25%, than in males, 1.17%.^[9] Despite the azygos system varying significantly,^[10,11] variations in the azygos venous system that affect the lungs are likely due to abnormalities during development.

During the fifth week of development, the main veins of the embryo are the vitelline, umbilical, and anterior and posterior cardinal veins. During the fifth to seventh weeks of development, the subcardinal, sacrocardinal, and supracardinal veins form. At this time, the body walls drain into the posterior cardinal vein, and then drain into longitudinal veins on either side of the body, the early azygos venous system, which still ultimately drains into the posterior cardinal vein. Over time, the left common cardinal vein regresses shunting blood from the veins of the left azygos line into the right azygos line. The azygos vein forms from the veins of the right azygos line and the most cranial part of the right posterior cardinal vein. As the left cardinal vein regresses, the cranial portion of the right posterior cardinal vein migrates from lateral to medial to its final position wrapping around the root of the right lung.^[12,13] Incomplete migration of the posterior cardinal vein medially can cause it to pierce the developing superior lobe of the right lung resulting in the formation of an azygos lobe, as observed here. As the azygos lobe lacks an associated secondary bronchus, it is not considered to be a true lobe of the right lung.^[5]

The azygos venous system itself is usually not affected by clinical pathologies. However, changes in the shape and contours of the veins of the azygos venous system, especially the azygos vein, often signify an underlying pathology: constrictive pericarditis, cardiac tamponade, pulmonary hypertension, or portal hypertension.^[2] Furthermore, the abnormal course of the azygos vein which results in an azygos lobe of the right lung leads to abnormal paratracheal opacities being observed on chest X-ray. These are often treated as a mediastinal lesion

leading to unnecessary surgical procedures of the thorax.^[5] Additionally, the azygos lobe may be unaffected by pathological processes occurring in the rest of the lung such as disseminated pulmonary tuberculosis,^[14] and pathologies of the azygos lobe often remain confined to the lobe making identification and treatment more difficult. For example, carcinomas of the azygos lobe are not associated with the involvement of the regional mediastinal lymph nodes.^[15] Knowledge of the anatomy of the azygos vein and its influence on associated structures such as the lungs are important to understand when interpreting imaging of the chest and during surgical procedures within the thoracic cage.

Conclusion

The azygos vein can pierce the superior lobe of the right lung forming an azygos lobe of the right lung which can be mistaken for mediastinal pathology. Documenting the presence and course of this variation in the azygos vein and its associated abnormal lung anatomy is important to avoid unnecessary procedures of the mediastinum and thorax.

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Conflict of Interest

The authors have no conflicts of interests to declare.

Author Contributions

AS: project development, data collection, manuscript writing/editing; RLH: data collection, manuscript writing/editing; NL: manuscript writing/editing; JF: manuscript writing/editing; MS: project development, manuscript writing/editing; AK: project development, manuscript writing/editing.

Ethics Approval

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